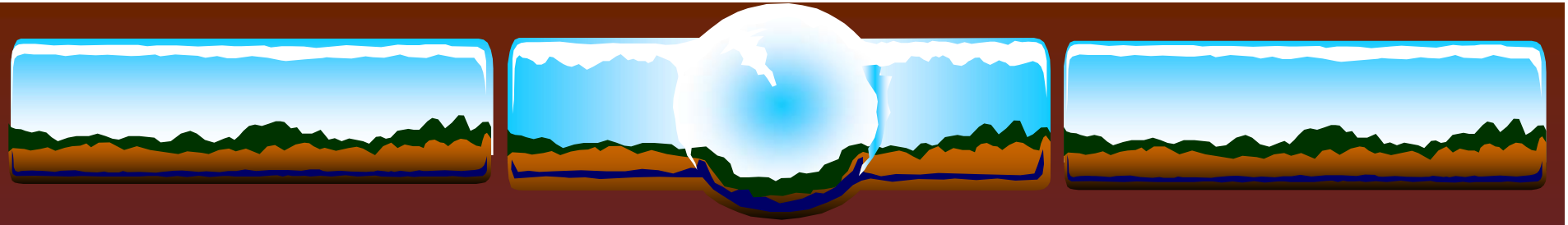


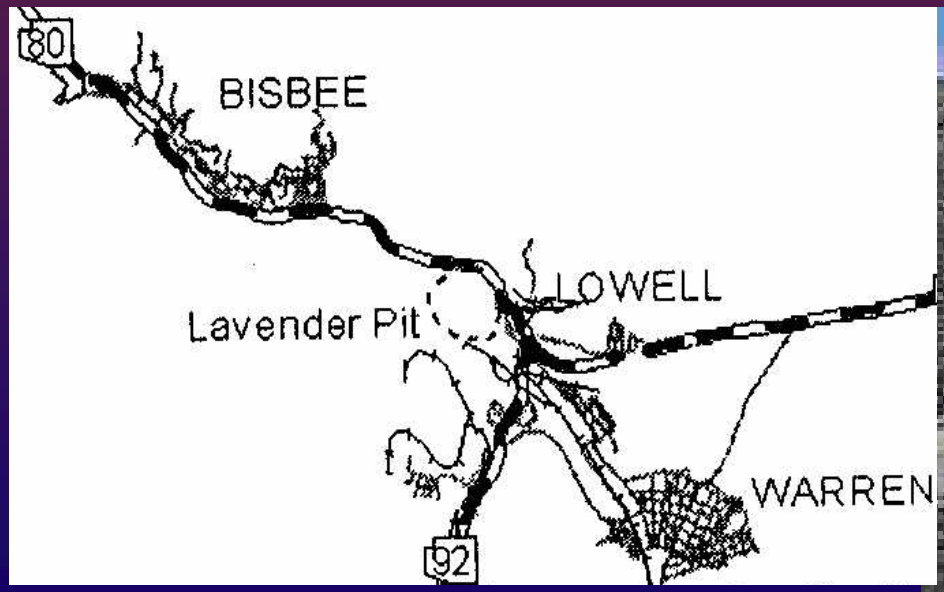
Mine Related Considerations For an Enhancement of SR 80

A: Project Specific

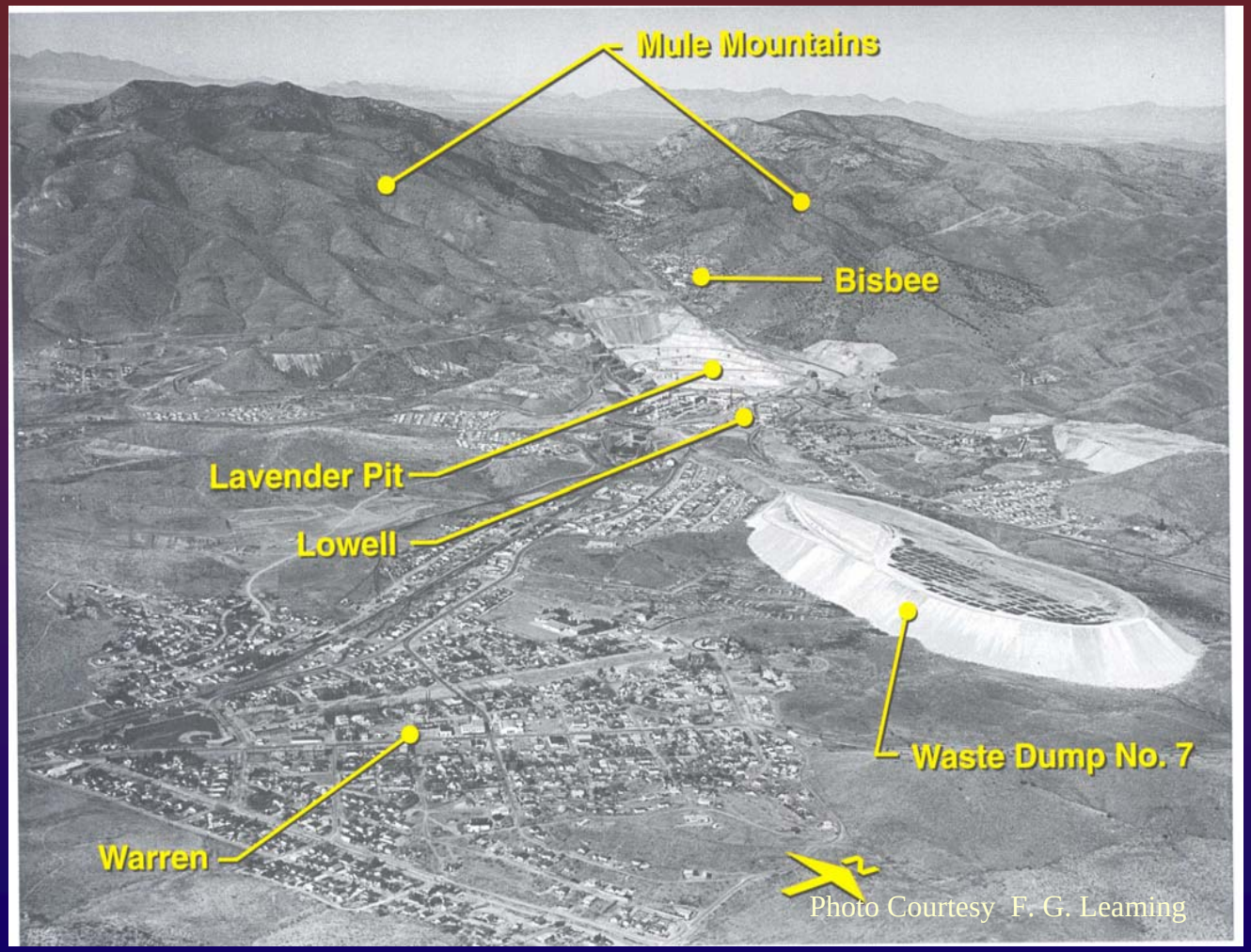
B: General Applications

LOCATION

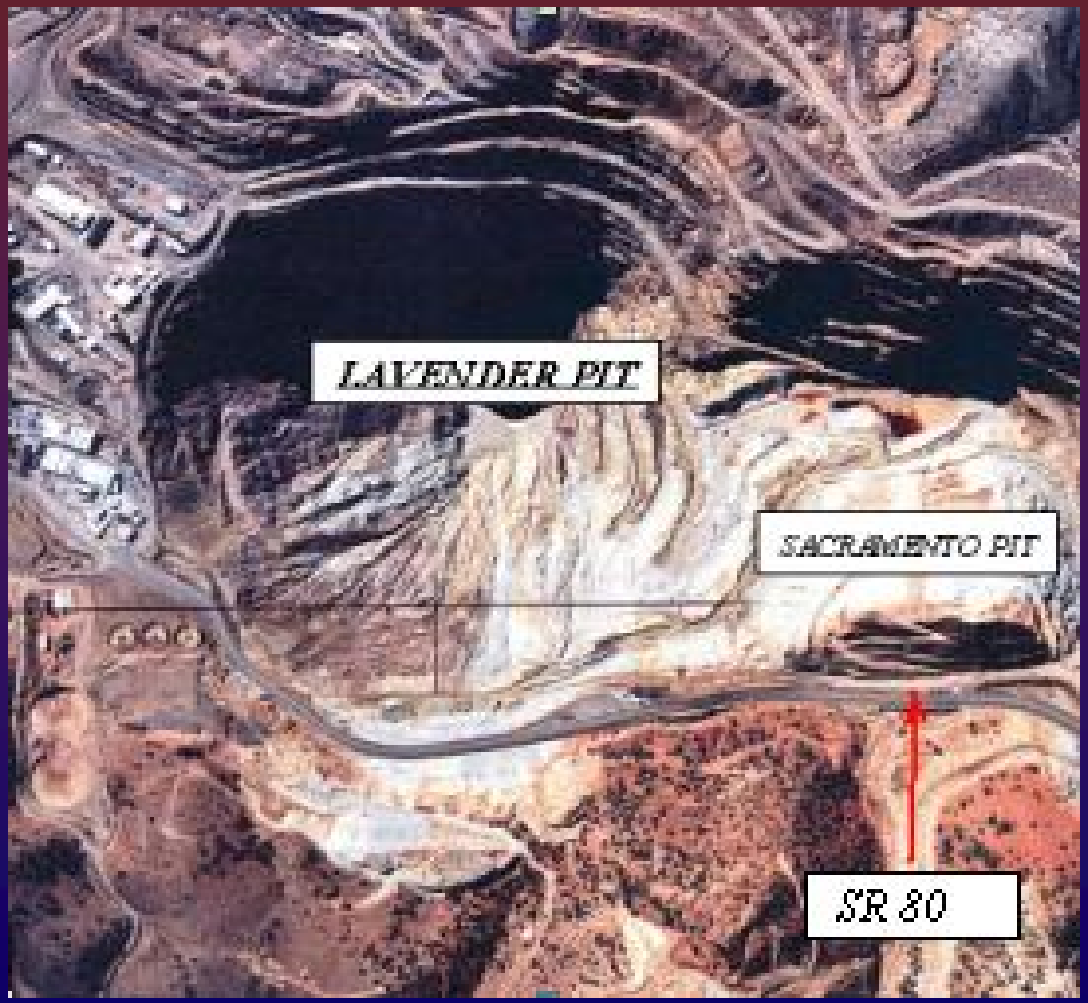
Cochise County, SE Arizona



Location


Mule Mountains
Bisbee
Lavender Pit
Lowell
Waste Dump No. 7
Warren
Photo Courtesy F. G. Leaming

Highway Alignment



GEOLOGY

Abstracted From Hays & Landis 1964

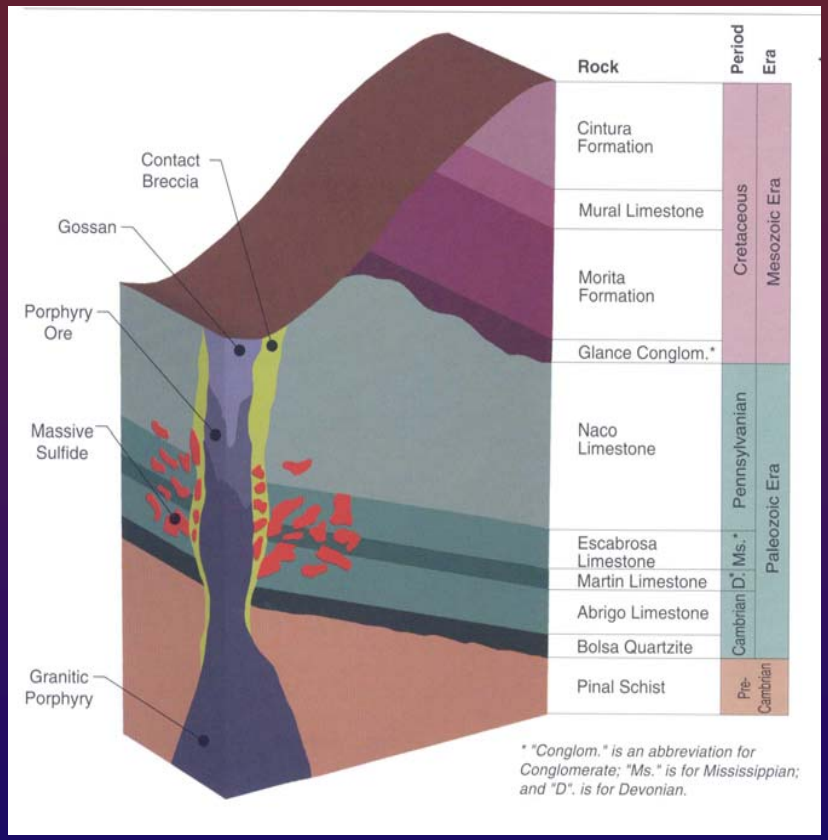
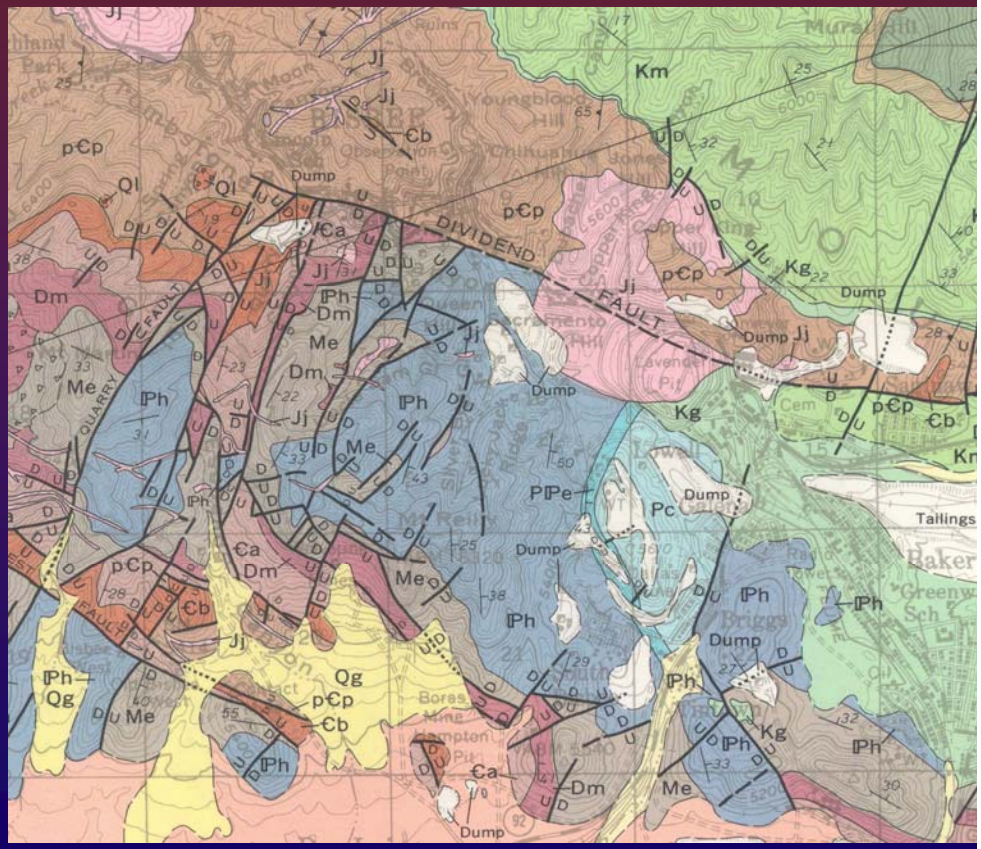


Image Courtesy F. G. Leaming



1950 Proposed Realignment Routes

Highway History

SR 80 Realigned in 1961 along the eastern boundary of the Lavender Pit

Incidents Of Concern

Settlement 1964

Maintenance 1965-1966

Settlement 1978

Tension Crack in Pavement 1987

Slope inclinometer monitoring 1987 to present

SETTLEMENT CONCERNS

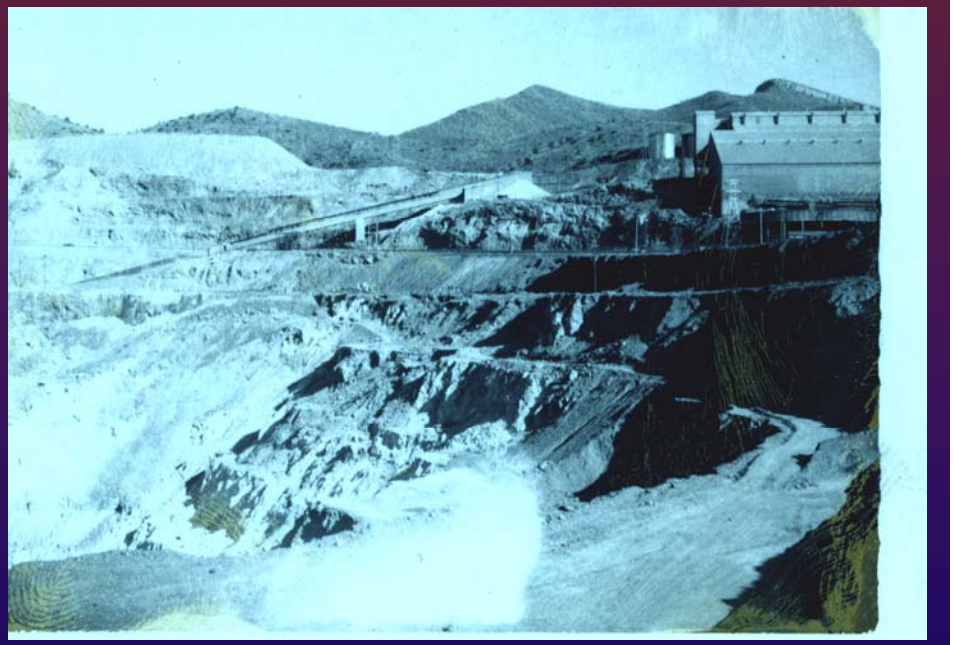
- 1964 Settlement

- 2002 Distress

Changes in Landscape

- 2002 Image

Early 1960's image

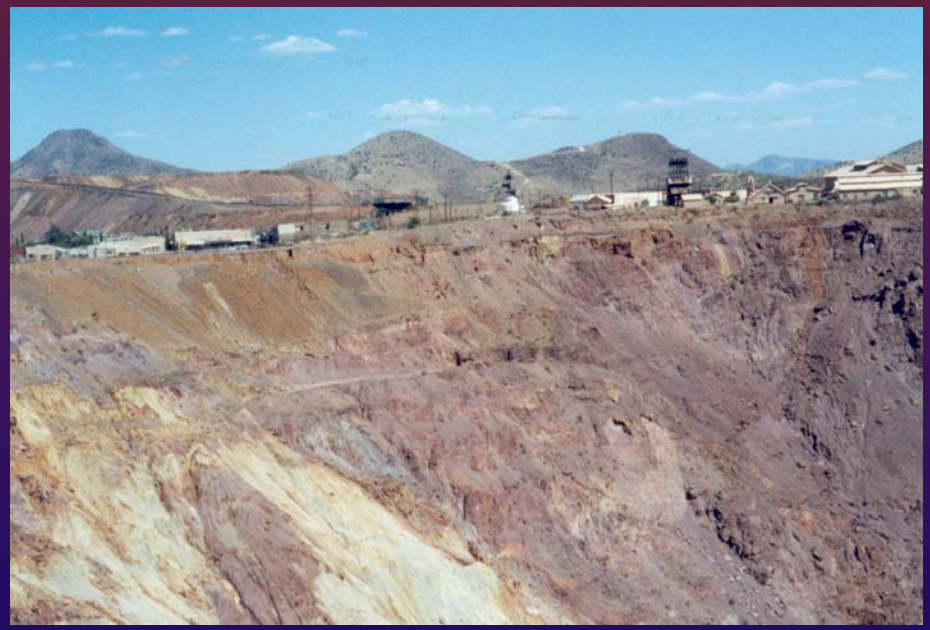


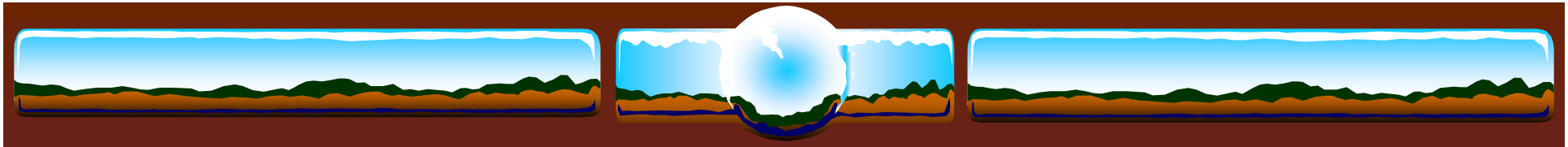
Features Near Lowell

Features Near Lowell

- 1984

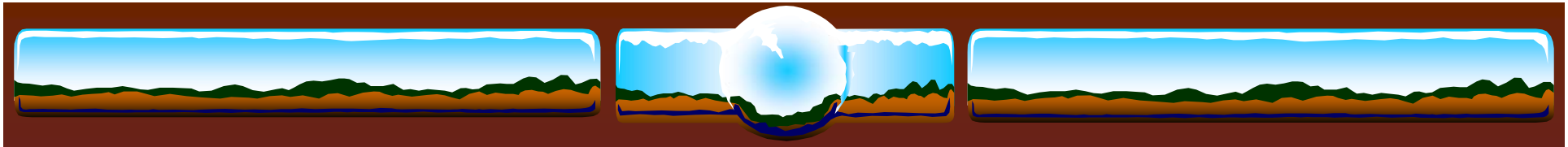
- 2002





Considerations for Designers

- Part of the planned infrastructure improvements incorporates areas that have demonstrated appreciable distress and settlement over the past 40 years. Both ADOT and Mine owner confirms these conditions
- Although the conditions are presently acceptable. The long term stability of these areas a still being evaluated. Any additional widening may require greater that average cost and efforts to construct.



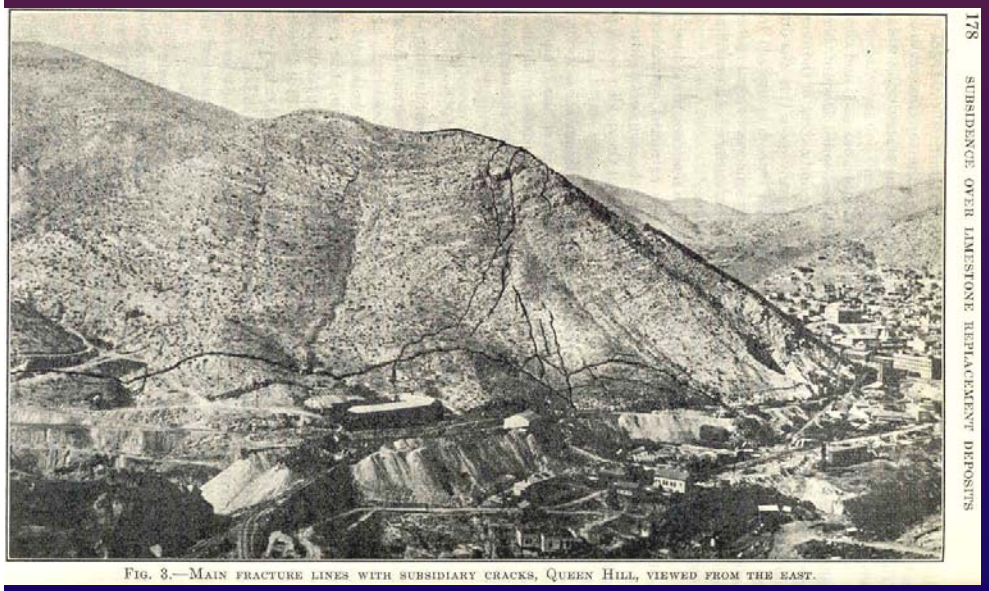
Considerations for Designers

- What is the present status of the adjacent lands?
- Is there a potential for new mine development that would destroy of negatively effect the planned improvements?

Subsidence

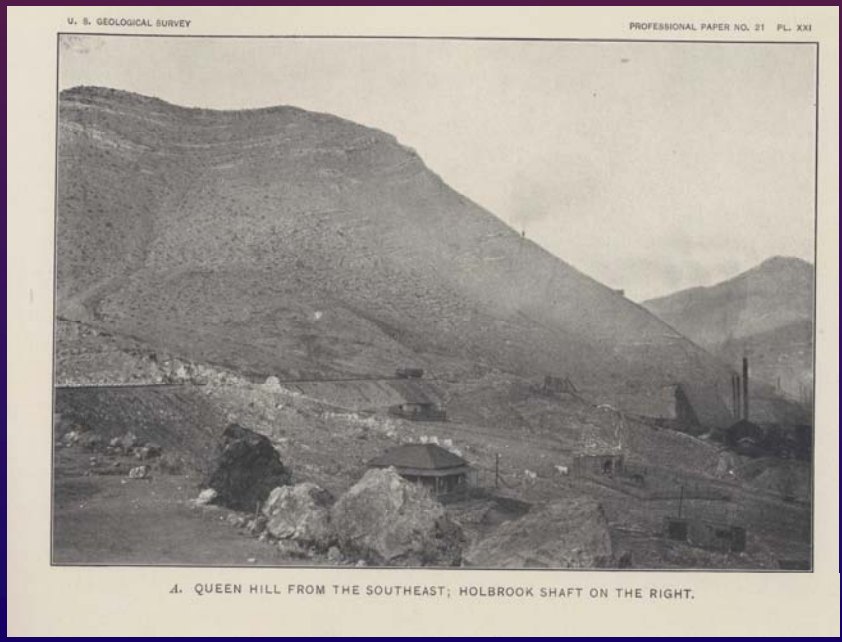
Queen Hill (Trischka 1934)

- From Ransome 1904



178 SUBSIDENCE OVER LIMESTONE REPLACEMENT DEPOSITS

FIG. 3.—MAIN FRACTURE LINES WITH SUBSIDIARY CRACKS, QUEEN HILL, VIEWED FROM THE EAST.



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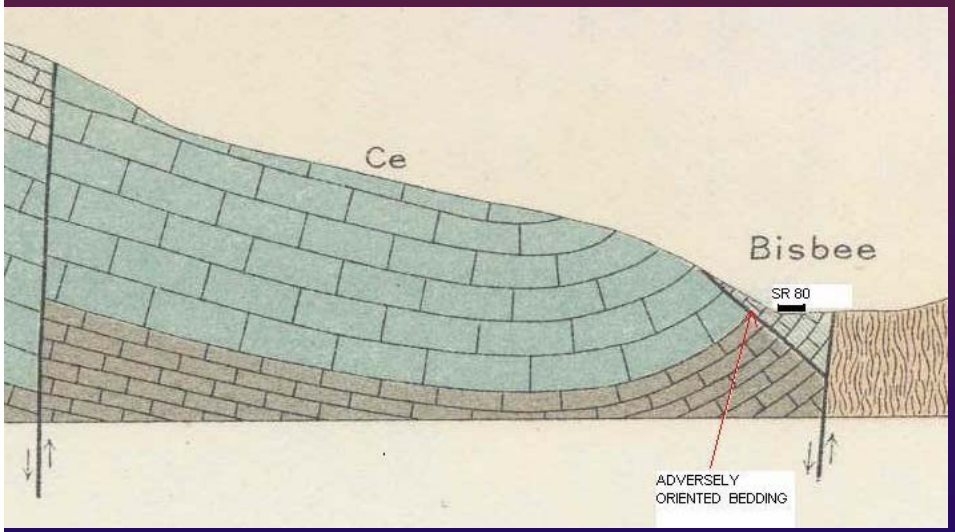
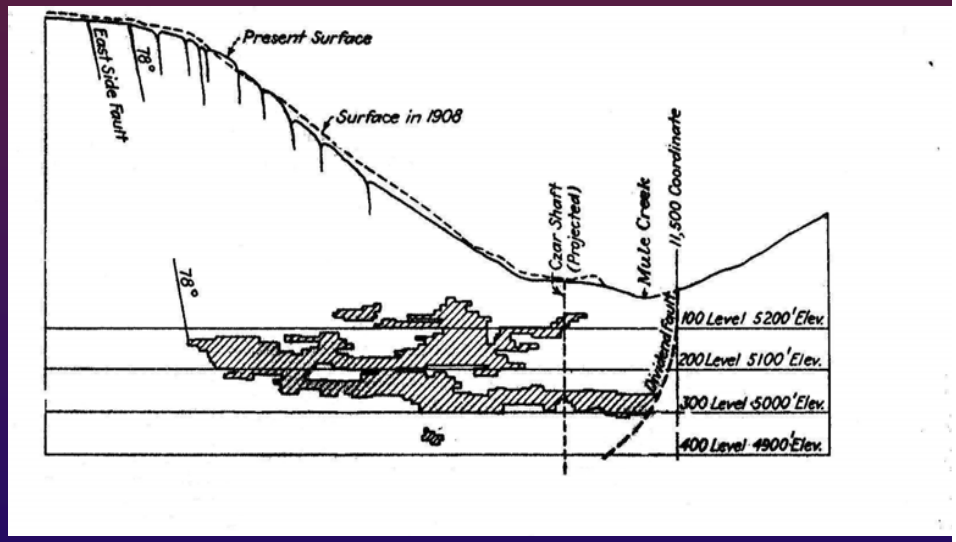
A. QUEEN HILL FROM THE SOUTHEAST; HOLBROOK SHAFT ON THE RIGHT.

Subsidence on Queen Hill

Ransome 1904

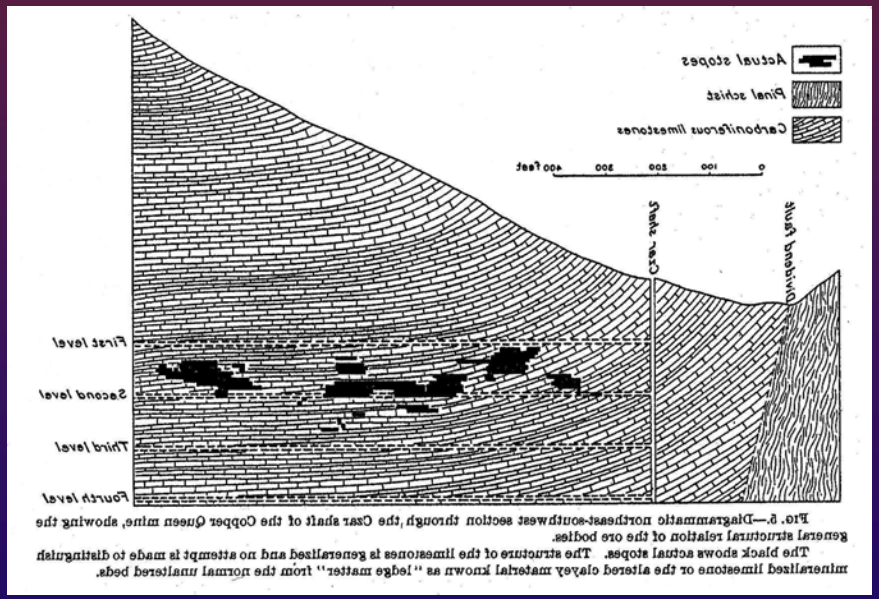


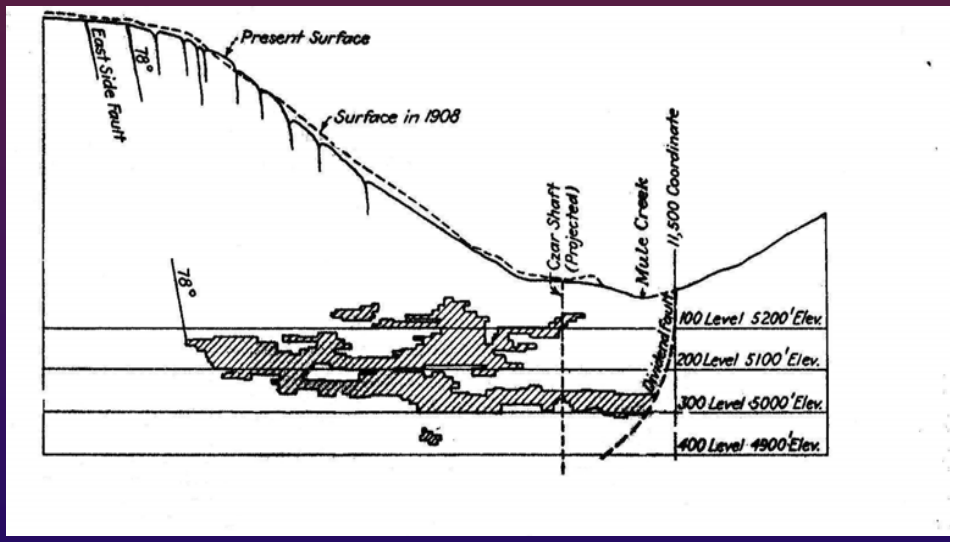
- Trischka 1934



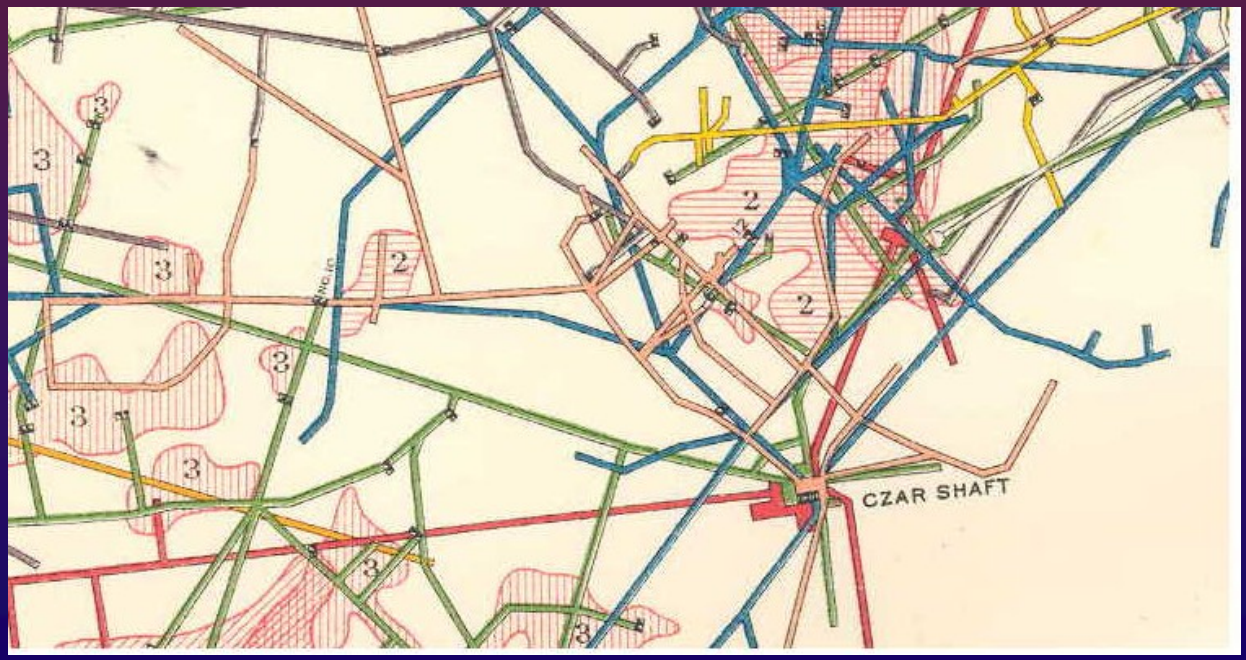
Subsidence of Queen Hill 1904-1934

- Ransome (1904)
- Trischka 1934

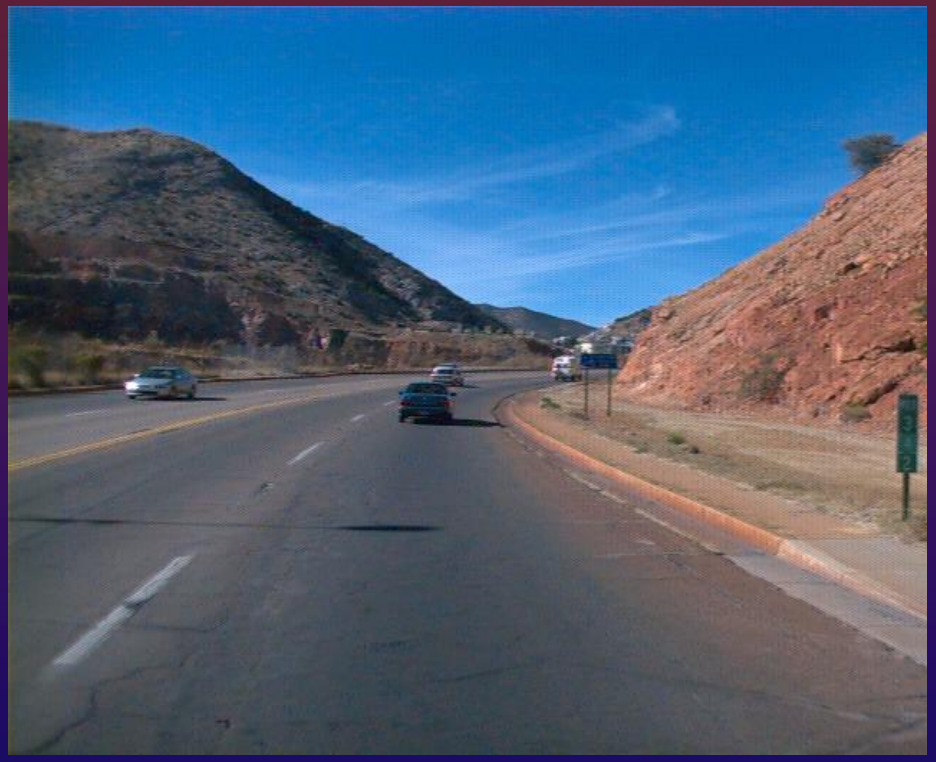


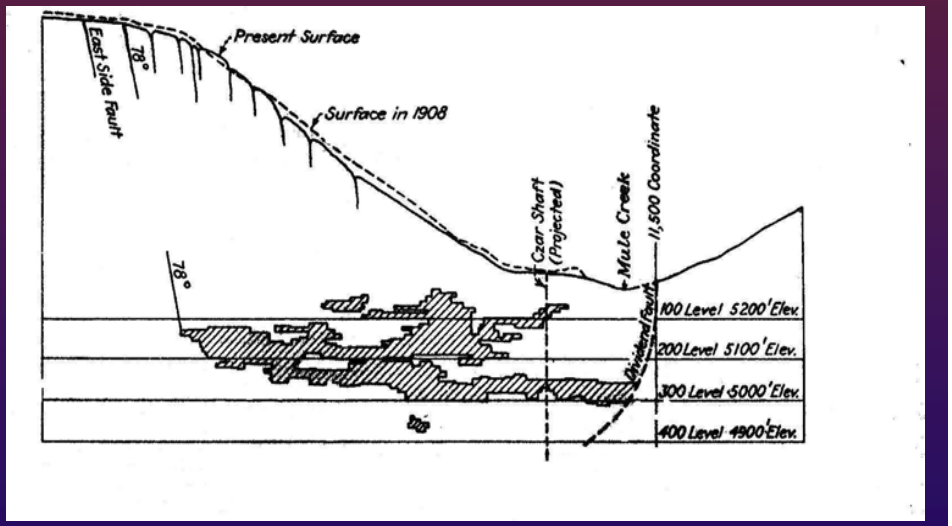


- Underground Workings beneath Queen Hill as reported by Ramsome 1904



Queen Hill Looking North From SR 80

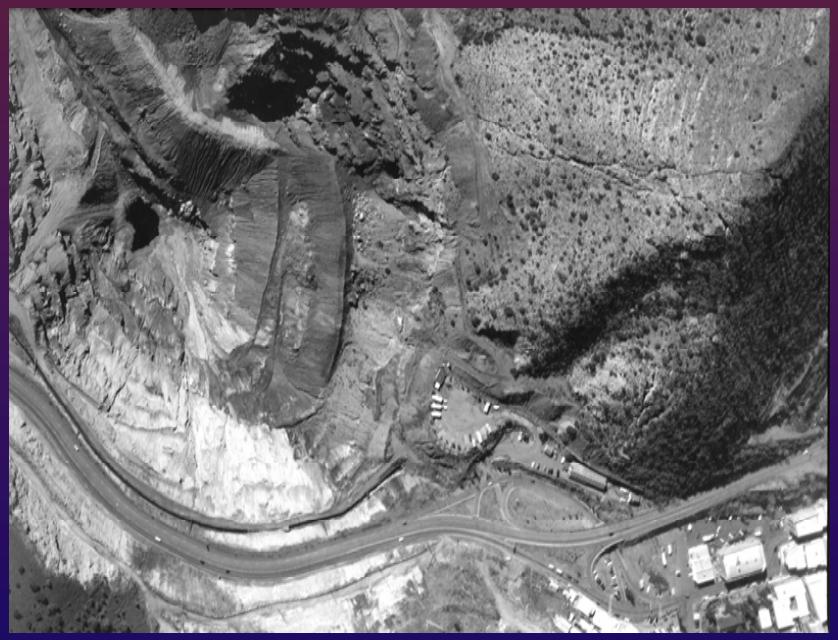




Air Photo Comparison

1964

2001



Fissure Development

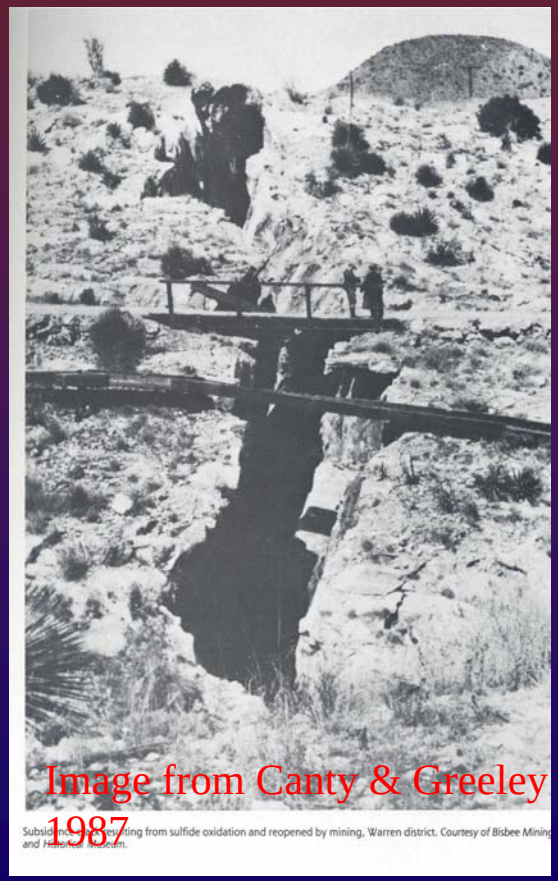


Image from Canty & Greeley 1987

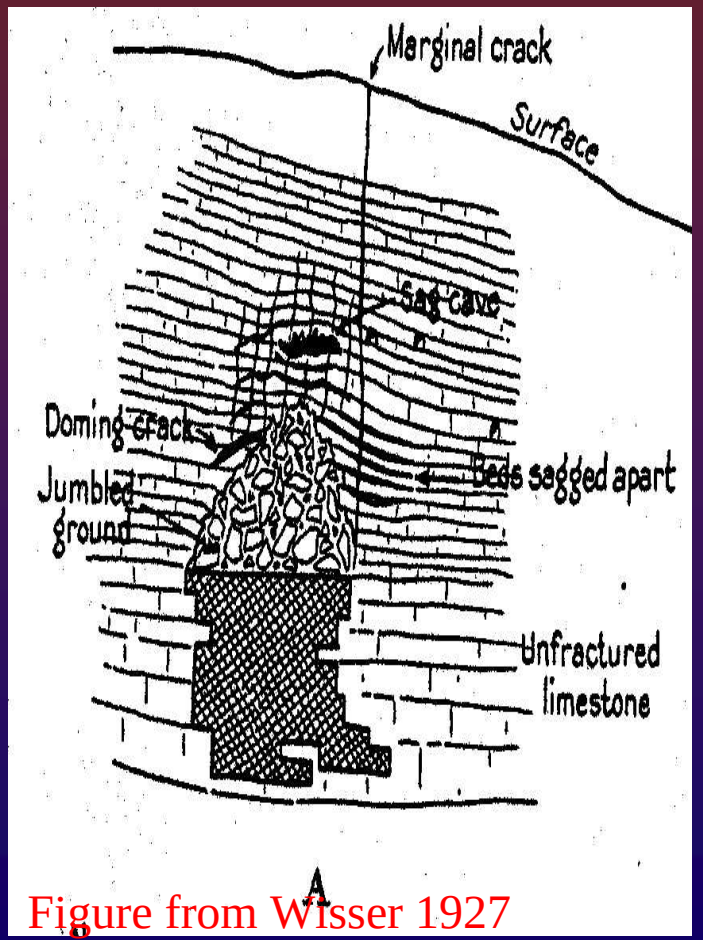
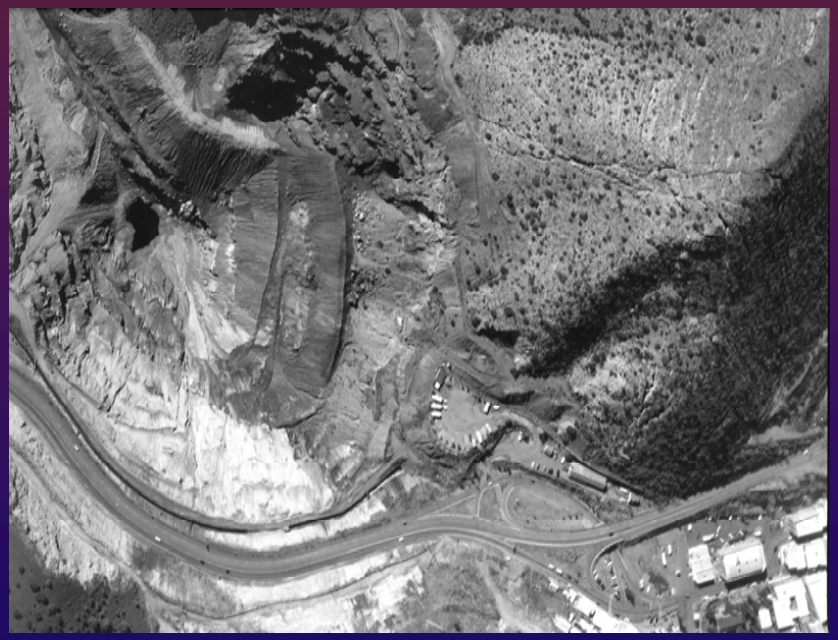


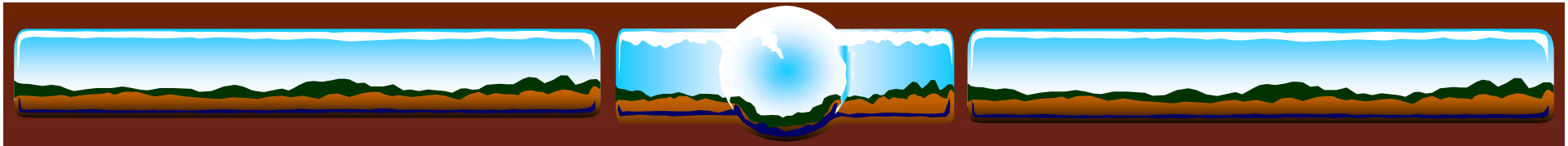
Figure from Wisser 1927

Air Photo Comparison

1964

2001





Trischka's Observation of Oxidation Subsidence in the vicinity of Queen Hill

Slumping results from the removal of iron and sulfur during the oxidation of sulfide ore bodies

Ore bodies shrinks in size, causing a cave to form above it

Breaks (cracks fissures) extends upward and may reach the surface.

Further subsidence caused by continued oxidation forming siderite below ore body

Mining activity accretes the subsidence process by removing ore supporting the enclosed rock material

Surface Expression of Fissure Development And Mining Activity ?

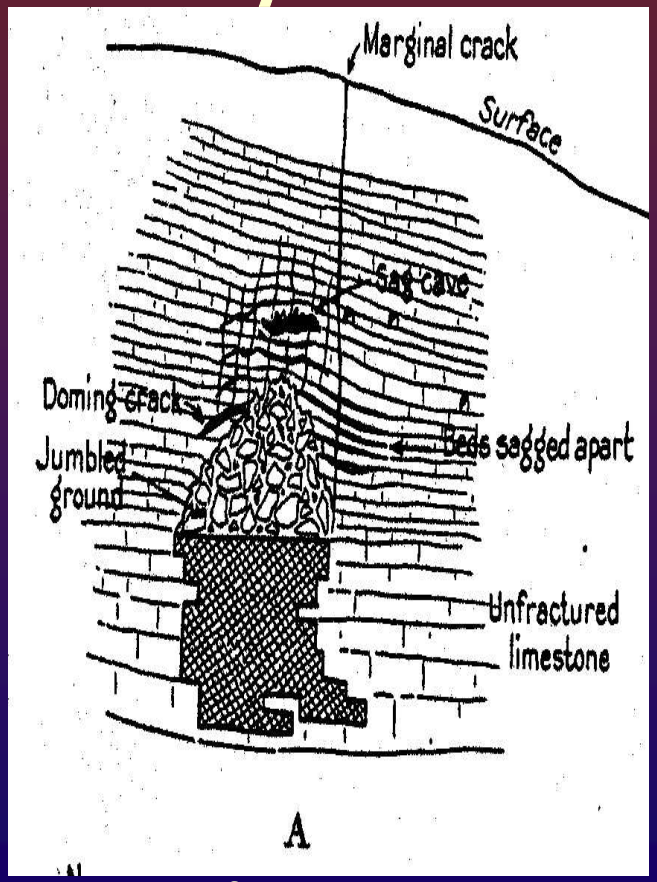
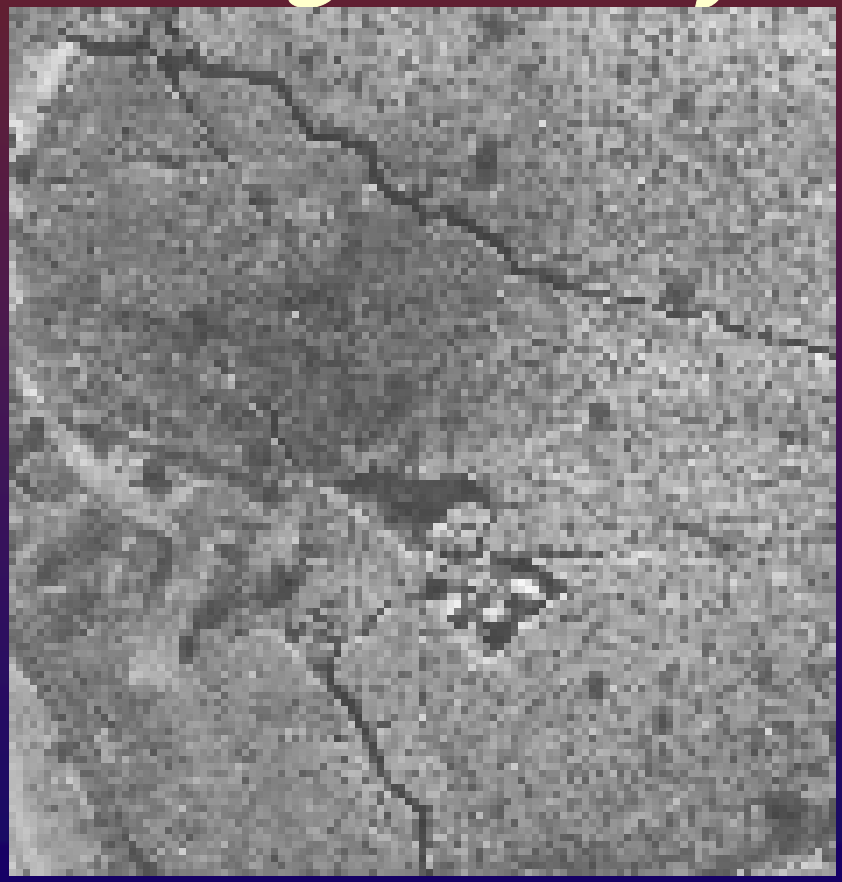
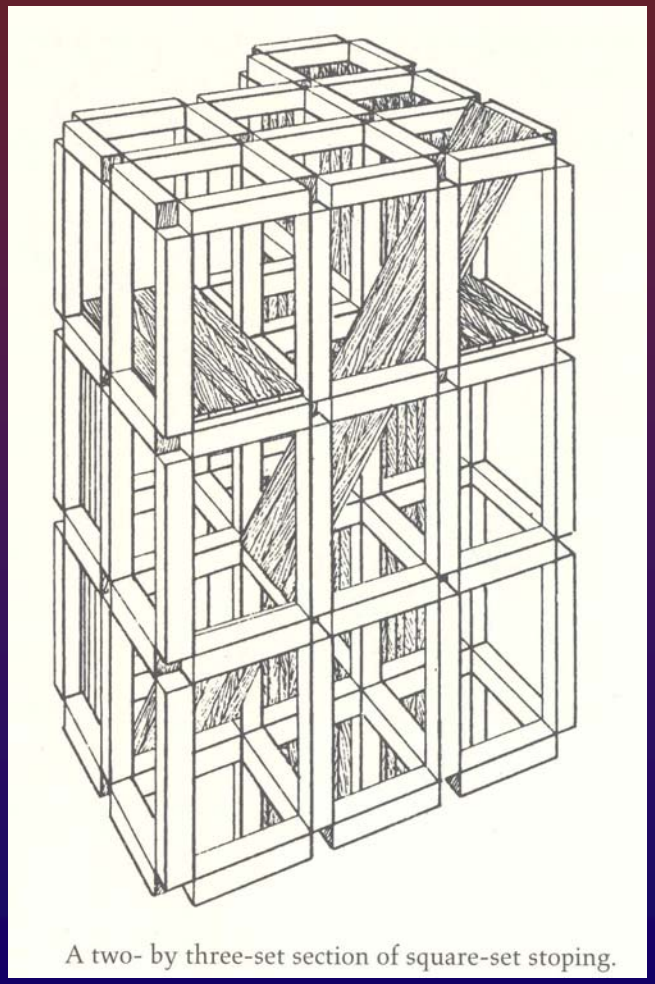


Figure from Wisser 1927

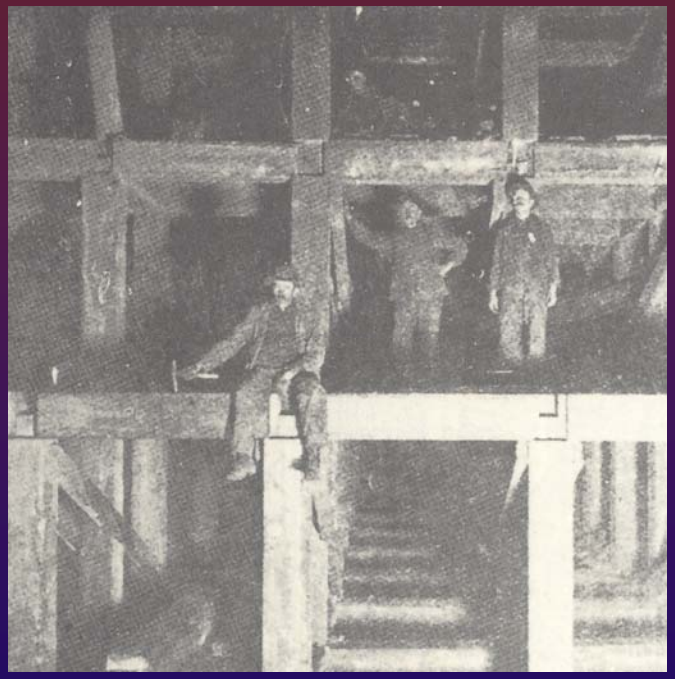


Surface Expression of Fissure Development / Mining Activity ?

Ground Support Timbered Stopes



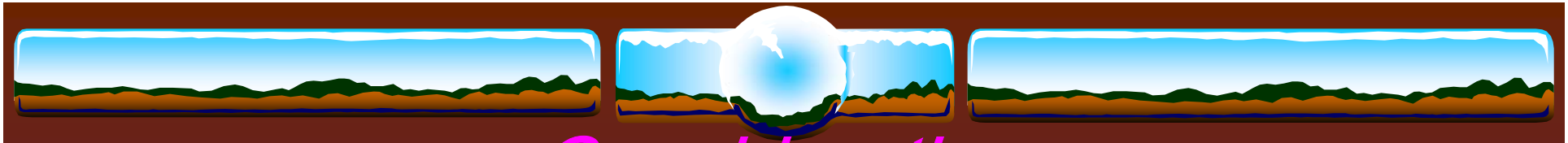
A two- by three-set section of square-set stoping.



Images Courtesy of Lyn Baily

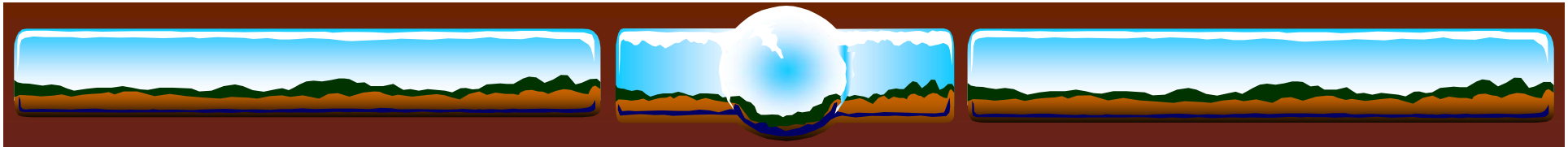
Considerations:

- Borrowing for Dr Singh SME 1986
- There appears to be several general misconceptions regarding subsidence in hard rock mining
- A: Depth of Mine (as measured by overburden) is suggested as a prevention or mitigation measure.
- B: Extraction area can be correlated with the size of the subsidence area.
- *IN GENERAL*
- The affected surface area is often larger than the extracted area
- Mining at any depth can result in subsidence
- The conditions on Queen Hill appear to confirm these statements



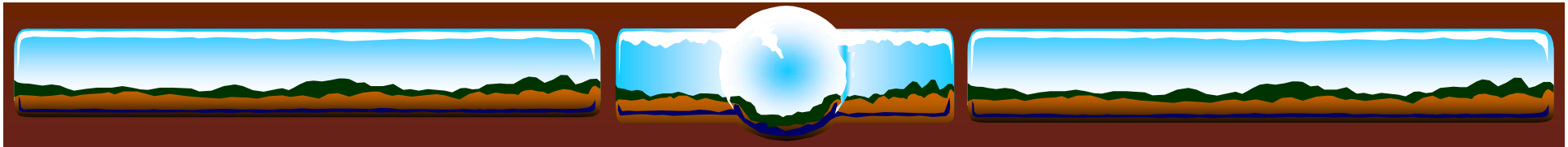
Considerations:

- *In the Vicinity of previously mined areas.*
- Include multidisplinary technical ability when planning alignment changes.
- Include additional reference and information sources
- Widen air photographic coverage to include areas outside of right of way limits and include multiple time periods. Many photo interpretation techniques are applicable
- Evaluate the existing site conditions with more scrutiny. The basic conservative parameters to which standard drawings have been developed for may not exist in a previously mined area.



Considerations:

- Evaluate the potential for hidden features. i.e. Areas that have been mined first by underground methods, then by open pits and later by leaching operations.
- Consider: Evaluating relic features now covered or partly obliterated by mine waste or the position newer mine developments I.e. backfilled mine shafts, covered fissures, old foundations as clues to past use.
- Evaluate truncated or diverted drainage systems
- Consider safety factors and serviceability which were established for mine life versus what is desired for highway infrastructure life.



Considerations:

- *For Example:*
- Life of square set timbers: Will there be any effects of failing underground support to existing topography? What is the estimated service life of underground timber support?
- Stability of Slopes: Has the conditions of mine slopes been allowed to deteriorate to the point that it may effect adjoining users?
- Existing mine dump fills may not be compacted to required density. Considerable re-work may be necessary to avoid differential settlement.